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SHARP

| No. | LD-K22569 |
|---|---|
| DATE | July. 21. 2010 |

# TECHNICAL LITERATURE FOR TFT - LCD module

MODEL No. LK400D3LB44

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**DEVELOPMENT DEPARTMENT. 1**
**LIQUID CRYSTAL DISPLAY DIVISION .1**
**LIQUID CRYSTAL DISPLAY GROUP**
**SHARP CORPORATION**

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# RECORDS OF REVISION

LK400D3LB44

| SPEC No. | DATE | REVISED No. | PAGE | SUMMARY | NOTE |
|---|---|---|---|---|---|
| LD-K22569 | July. 21. 2010 | - | - | - | 1st. Issue |

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## 1. Application

This technical literature applies to the color 40.0" TFT-LCD module LK400D3LB44.

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## 2. Overview

This module is a color active matrix LCD module incorporating amorphous silicon TFT (Thin Film Transistor). It is composed of a color TFT-LCD panel, driver ICs, control circuit, power supply circuit, LED drive circuit and back light system etc. Graphics and texts can be displayed on a 1920×RGB×1080 dots panel with one billion colors by using LVDS (Low Voltage Differential Signaling) to interface, +12V of DC supply voltages.

This module includes the LED backlight system. (Typ. +64.25V of DC supply voltage)

And in order to improve the response time of LCD, this module applies the Over Shoot driving (O/S driving) technology for the control circuit .In the O/S driving technology, signals are being applied to the Liquid Crystal according to a pre-fixed process as an image signal of the present frame when a difference is found between image signal of the previous frame and that of the current frame after comparing them.

With this technology, image signals can be set so that liquid crystal response completes within one frame. As a result, motion blur reduces and clearer display performance can be realized.

This LCD module also adopts 120Hz Frame Rate driving method.

With combination of these technologies, motion blur can be reduced and clearer display performance can be realized.

## 3. Mechanical Specifications

| Parameter | Specifications | Unit |
|---|---|---|
| Display size | 101.609 (Diagonal) | cm |
| | 40.0 (Diagonal) | inch |
| Active area | 885.6 (H) x 498.15 (V) | mm |
| Pixel Format | 1920 (H) x 1080 (V)<br>(1pixel = R + G + B dot) | pixel |
| Pixel pitch | 0.46125 (H) x 0.46125 (V) | mm |
| Pixel configuration | R, G, B vertical stripe | |
| Display mode | Normally black | |
| Unit Outline Dimensions (*1) | 921.7 (H) x 535.7 (V) x (20.8) (D) (max) | mm |
| Mass | 7.8 kg (Tentative) | kg |
| Surface treatment | Anti glare<br>Hard coating: 2H and more | |

(*1) Outline dimensions are shown in Fig.1 (excluding protruding portion)

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## 4. Input Terminals

### 4.1. TFT panel driving

CN1 (Interface signals and +12V DC power supply)

Using connector : FI-RNE51SZ-HF (Japan Aviation Electronics Ind., Ltd.)

Mating connector : FI-RE51HL, FI-RE51CL (Japan Aviation Electronics Ind., Ltd.)

Mating LVDS transmitter : THC63LVD1023 or equivalent device

| Pin No. | Symbol | Function | Remark |
|---|---|---|---|
| 1 | GND | | |
| 2 | Reserved | N.C | |
| 3 | Reserved | N.C | |
| 4 | Reserved | N.C | |
| 5 | FRAME | Frame frequency setting 50Hz/60Hz | |
| 6 | Reserved | N.C | |
| 7 | SELLVDS | Select LVDS data order [Note 1,2,3] | Pull down : (GND) |
| 8 | Reserved | N.C | |
| 9 | Reserved | N.C | |
| 10 | Reserved | N.C | |
| 11 | GND | | |
| 12 | AIN0- | Aport (-)LVDS CH0 differential data input | |
| 13 | AIN0+ | Aport (+)LVDS CH0 differential data input | |
| 14 | AIN1- | Aport (-)LVDS CH1 differential data input | |
| 15 | AIN1+ | Aport (+)LVDS CH1 differential data input | |
| 16 | AIN2- | Aport (-)LVDS CH2 differential data input | |
| 17 | AIN2+ | Aport (+)LVDS CH2 differential data input | |
| 18 | GND | | |
| 19 | ACK- | Aport LVDS Clock signal(-) | |
| 20 | ACK+ | Aport LVDS Clock signal(+) | |
| 21 | GND | | |
| 22 | AIN3- | Aport (-)LVDS CH3 differential data input | |
| 23 | AIN3+ | Aport (+)LVDS CH3 differential data input | |
| 24 | AIN4- | Aport (-)LVDS CH4 differential data input | |
| 25 | AIN4+ | Aport (+)LVDS CH4 differential data input | |
| 26 | GND | | |
| 27 | GND | | |
| 28 | BIN0- | Bport (-)LVDS CH0 differential data input | |
| 29 | BIN0+ | Bport (+)LVDS CH0 differential data input | |
| 30 | BIN1- | Bport (-)LVDS CH1 differential data input | |
| 31 | BIN1+ | Bport (+)LVDS CH1 differential data input | |
| 32 | BIN2- | Bport (-)LVDS CH2 differential data input | |
| 33 | BIN2+ | Bport (+)LVDS CH2 differential data input | |
| 34 | GND | | |
| 35 | BCK- | Bport LVDS Clock signal(-) | |
| 36 | BCK+ | Bport LVDS Clock signal(+) | |
| 37 | GND | | |
| 38 | BIN3- | Bport (-)LVDS CH3 differential data input | |
| 39 | BIN3+ | Bport (+)LVDS CH3 differential data input | |
| 40 | BIN4- | Bport (-)LVDS CH4 differential data input | |
| 41 | BIN4+ | Bport (+)LVDS CH4 differential data input | |
| 42 | GND | | |
| 43 | GND | | |
| 44 | GND | | |

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| | | | |
|---|---|---|---|
| 45 | GND | | |
| 46 | GND | | |
| 47 | VCC | +12V Power Supply | |
| 48 | VCC | +12V Power Supply | |
| 49 | VCC | +12V Power Supply | |
| 50 | VCC | +12V Power Supply | |
| 51 | VCC | +12V Power Supply | |

CN2 (Interface signals)

Using connector : FI-RNE41SZ-HF (Japan Aviation Electronics Ind., Ltd.)

Mating connector : FI-RE41HL, FI-RE41CL (Japan Aviation Electronics Ind., Ltd.) or equivalent device

| Pin No. | Symbol | Function | Remark |
|---|---|---|---|
| 1 | Reserved | | |
| 2 | Reserved | | |
| 3 | Reserved | | |
| 4 | Reserved | | |
| 5 | Reserved | | |
| 6 | Reserved | | |
| 7 | Reserved | | |
| 8 | Reserved | | |
| 9 | GND | | |
| 10 | CIN0- | Cport (-)LVDS CH0 differential data input | |
| 11 | CIN0+ | Cport (+)LVDS CH0 differential data input | |
| 12 | CIN1- | Cport (-)LVDS CH1 differential data input | |
| 13 | CIN1+ | Cport (+)LVDS CH1 differential data input | |
| 14 | CIN2- | Cport (-)LVDS CH2 differential data input | |
| 15 | CIN2+ | Cport (+)LVDS CH2 differential data input | |
| 16 | GND | | |
| 17 | CCK- | Cport LVDS Clock signal(-) | |
| 18 | CCK+ | Cport LVDS Clock signal(+) | |
| 19 | GND | | |
| 20 | CIN3- | Cport (-)LVDS CH3 differential data input | |
| 21 | CIN3+ | Cport (+)LVDS CH3 differential data input | |
| 22 | CIN4- | Cport (-)LVDS CH4 differential data input | |
| 23 | CIN4+ | Cport (+)LVDS CH4 differential data input | |
| 24 | GND | | |
| 25 | GND | | |
| 26 | DIN0- | Dport (-)LVDS CH0 differential data input | |
| 27 | DIN0+ | Dport (+)LVDS CH0 differential data input | |
| 28 | DIN1- | Dport (-)LVDS CH1 differential data input | |
| 29 | DIN1+ | Dport (+)LVDS CH1 differential data input | |
| 30 | DIN2- | Dport (-)LVDS CH2 differential data input | |
| 31 | DIN2+ | Dport (+)LVDS CH2 differential data input | |
| 32 | GND | | |
| 33 | DCK- | Dport LVDS Clock signal(-) | |
| 34 | DCK+ | Dport LVDS Clock signal(+) | |
| 35 | GND | | |
| 36 | DIN3- | Dport (-)LVDS CH3 differential data input | |
| 37 | DIN3+ | Dport (+)LVDS CH3 differential data input | |
| 38 | DIN4- | Dport (-)LVDS CH4 differential data input | |
| 39 | DIN4+ | Dport (+)LVDS CH4 differential data input | |
| 40 | GND | | |
| 41 | GND | | |

[Note] GND of a liquid crystal panel drive part has connected with a module chassis.

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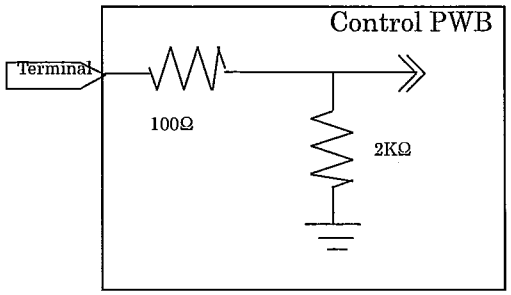
[Note 1] The equivalent circuit figure of the terminal




[Note 2] LVDS Data order

| SELLVDS | | |
|---|---|---|
| Data | L(GND) or OPEN [VESA] | H(3.3V) [JEIDA] |
| TA0 | R0(LSB) | R4 |
| TA1 | R1 | R5 |
| TA2 | R2 | R6 |
| TA3 | R3 | R7 |
| TA4 | R4 | R8 |
| TA5 | R5 | R9(MSB) |
| TA6 | G0(LSB) | G4 |
| TB0 | G1 | G5 |
| TB1 | G2 | G6 |
| TB2 | G3 | G7 |
| TB3 | G4 | G8 |
| TB4 | G5 | G9(MSB) |
| TB5 | B0(LSB) | B4 |
| TB6 | B1 | B5 |
| TC0 | B2 | B6 |
| TC1 | B3 | B7 |
| TC2 | B4 | B8 |
| TC3 | B5 | B9(MSB) |
| TC4 | NA | NA |
| TC5 | NA | NA |
| TC6 | DE(*) | DE(*) |
| TD0 | R6 | R2 |
| TD1 | R7 | R3 |
| TD2 | G6 | G2 |
| TD3 | G7 | G3 |
| TD4 | B6 | B2 |
| TD5 | B7 | B3 |
| TD6 | N/A | N/A |
| TE0 | R8 | R0(LSB) |
| TE1 | R9(MSB) | R1 |
| TE2 | G8 | G0(LSB) |
| TE3 | G9(MSB) | G1 |
| TE4 | B8 | B0(LSB) |
| TE5 | B9(MSB) | B1 |
| TE6 | N/A | N/A |

NA: Not Available
(*)Since the display position is prescribed by the rise of DE(Display Enable) signal, please do not fix DE signal during operation at "High".

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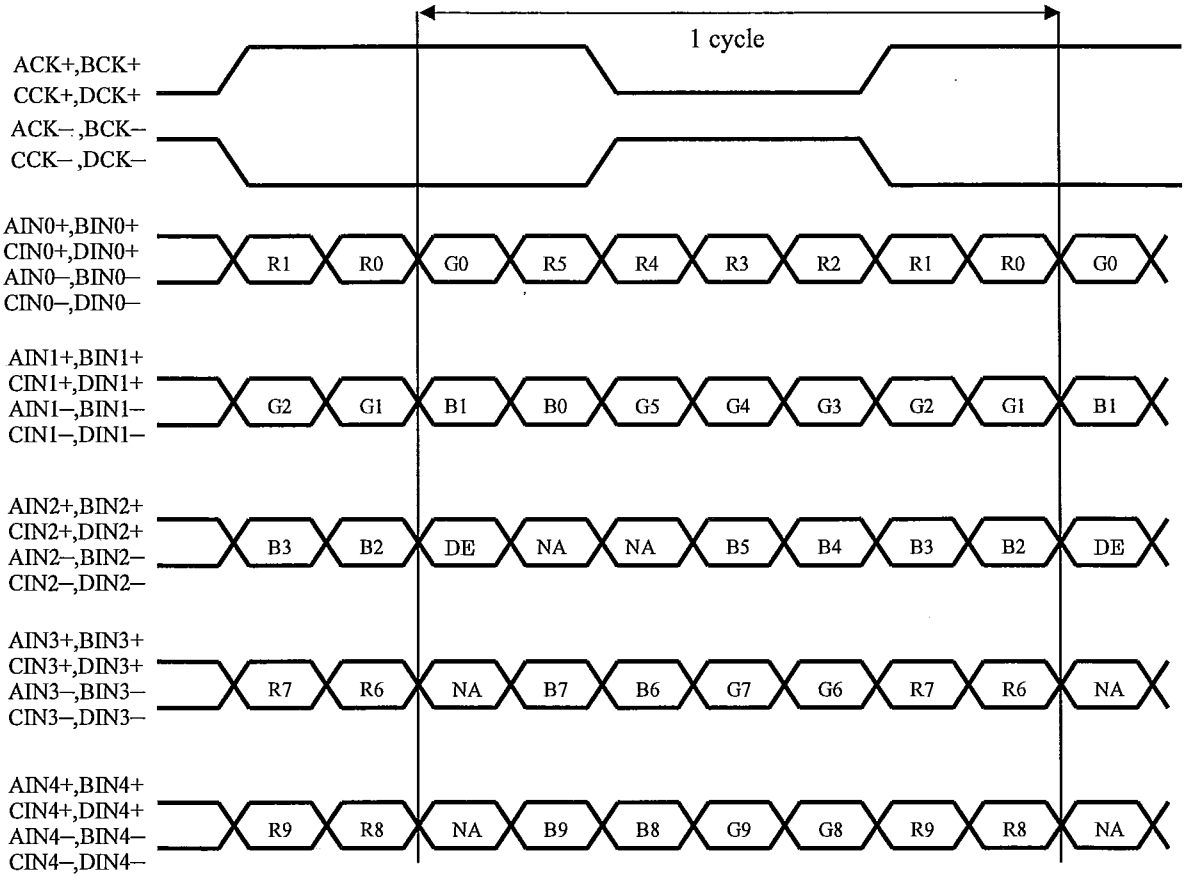
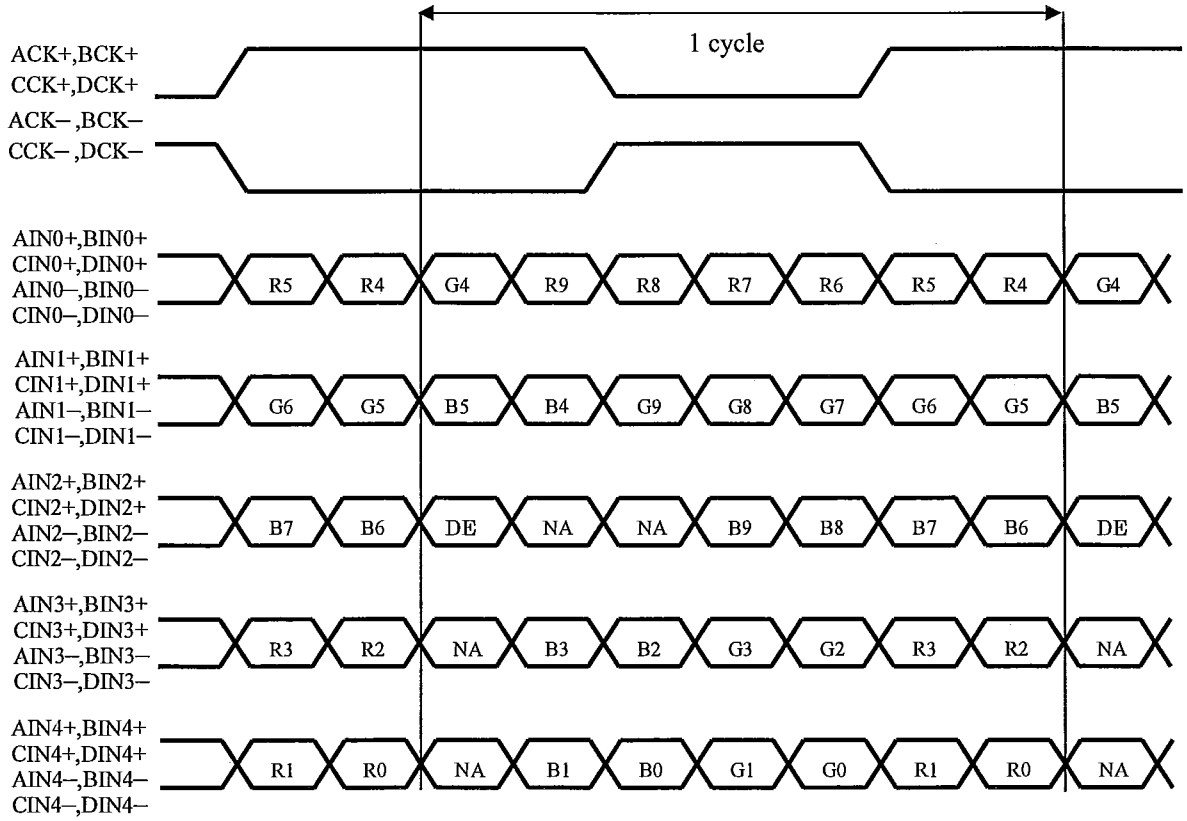
[Note 3]

**SELLVDS= Low (GND) or OPEN**




**SELLVDS= High (3.3V)**




DE: Display Enable, NA: Not Available (Fixed Low)

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4.2. Interface block diagram

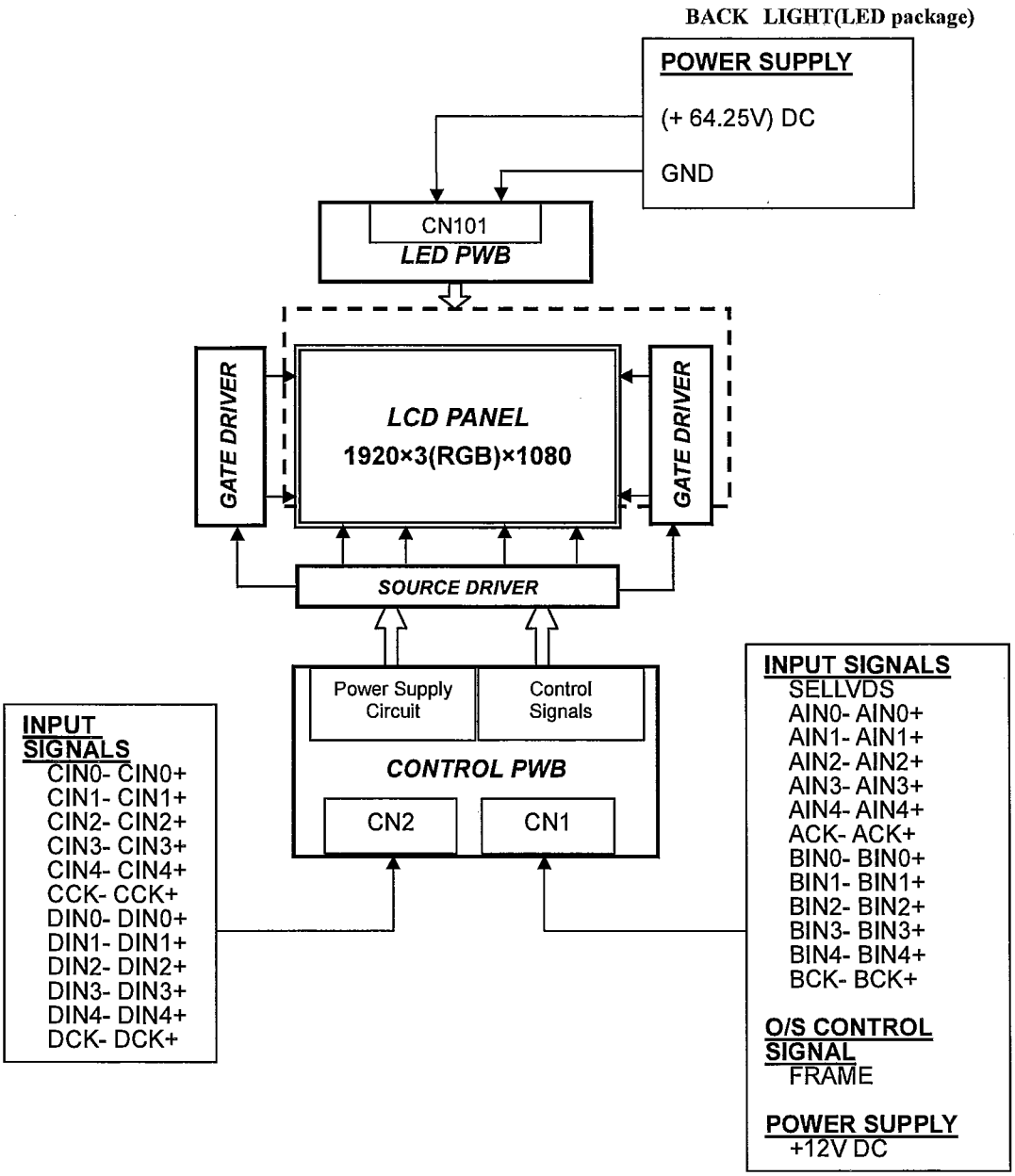


**Fig.1** Interface block diagram

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**Backlight driving**

4.3. Backlight driving (Tentative)

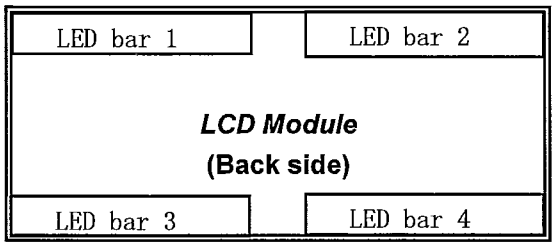
CN101 (DC power supply)

Using connector: 51103-1500 (Molex)

Mating connector: 51198-1500 (Molex)

| Pin No. | Symbol | Function | Remark |
|---|---|---|---|
| 1 | $V_{LED1}$ | DC power supply | (+64.25V) [Note 1] |
| 2 | NC | NC | |
| 3 | GND | GND | |
| 4 | NC | NC | |
| 5 | $V_{LED2}$ | DC power supply | (+64.25V) [Note 1] |
| 6 | NC | NC | |
| 7 | GND | GND | |
| 8 | NC | NC | |
| 9 | $V_{LED3}$ | DC power supply | (+64.25V) [Note 1] |
| 10 | NC | NC | |
| 11 | GND | GND | |
| 12 | NC | NC | |
| 13 | $V_{LED4}$ | DC power supply | (+64.25V) [Note 1] |
| 14 | NC | NC | |
| 15 | GND | GND | |

[Note 1] LED bar position




4.4. The back light system characteristics

The characteristics of the LED are shown in the following table. The value mentioned below is at the case of one LED.

| Item | Symbol | Min. | Typ. | Max. | Unit | Remarks |
|---|---|---|---|---|---|---|
| Life time | $T_{LED}$ | - | (T.B.D) | - | Hour | |

## 5. Absolute Maximum Ratings

| Parameter | Symbol | Condition | Ratings | Unit | Remark |
|---|---|---|---|---|---|
| Input voltage (for Control) | $V_I$ | Ta=25°C | -0.3 ~ 3.6 | V | [Note 1] |
| 12V supply voltage (for Control) | VCC | Ta=25°C | 0 ~ + 14 | V | |
| Input voltage (for Inverter) | $V_{ON}$ $V_{BRT}$ $V_{BRT_sel}$ | Ta=25°C | 0 ~ + 6 | V | |
| (64.25)V supply voltage (for LED driver) | $V_{LED\,n}$ | Ta=25 °C | 0 ~ +(T.B.D) | V | |
| Storage temperature | Tstg | - | -10 ~ +60 | °C | [Note 2] |
| Operation temperature (Ambient) | Topa | - | 0 ~ +50 | °C | |

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[Note 1] SELLVDS

[Note 2] Humidity 95%RH Max.(Ta≦40°C)

Maximum wet-bulb temperature at 39 °C or less.(Ta>40°C)

No condensation.

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## 6. Electrical Characteristics

6.1. Control circuit driving Ta=25 °C

| Parameter | | Symbol | Min. | Typ. | Max. | Uniit | Remark |
|---|---|---|---|---|---|---|---|
| +12V supply voltage | Supply voltage | Vcc | 11.4 | 12 | 12.6 | V | [Note 1] |
| | Current dissipation | Icc | - | T.B.D. | - | A | [Note 2] |
| | Inrush current | $I_{RUSH}1$ | - | T.B.D. | - | A | t1=500 μ s [Note 6] |
| | | $I_{RUSH}2$ | - | T.B.D. | - | A | t1>5ms |
| Permissible input ripple voltage | | $V_{RP}$ | - | - | 100 | $mV_{P-P}$ | Vcc = +12.0V |
| Input Low voltage | | $V_{IL}$ | 0 | - | 1.0 | V | [Note 3] |
| Input High voltage | | $V_{IH}$ | 2.3 | - | 3.3 | V | |
| Input leak current (Low) | | $I_{IL1}$ | - | - | 100 | μA | $V_I$ = 0V [Note 4] |
| Input leak current (High) | | $I_{IH1}$ | - | - | 100 | μA | $V_I$ = 3.3V [Note 4] |
| Terminal resistor | | $R_T$ | - | 100 | - | Ω | Differential input |
| Input Differential voltage | | \|VID\| | 200 | 400 | 600 | mV | [Note 5] |
| Differential input common mode voltage | | VCM | \|VID\|/2 | 1.2 | 2.4-\|VID\|/2 | V | [Note 5] |

[Note] $V_{CM}$: Common mode voltage of LVDS driver.

[Note 1]

Input voltage sequences

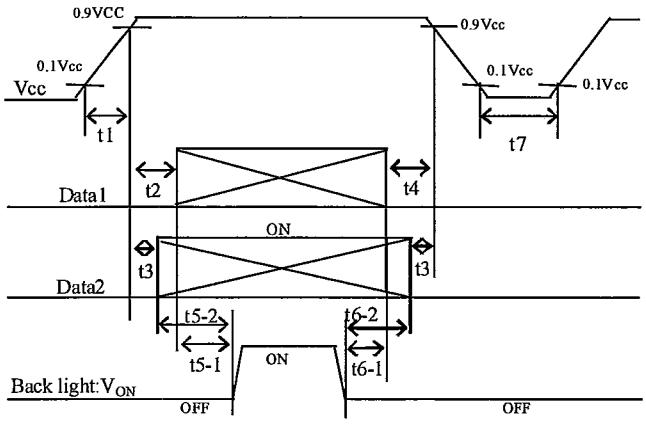
50ns < t1 < 20ms
20ms < t2 < 50ms
20ms < t3 < 50ms

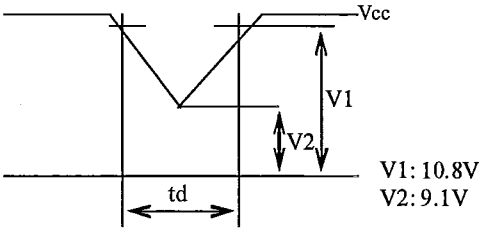
0 < t4 < 1s
t5-1 > 1s
t5-2 > 1s
t6 -1> 0
t6 -2> 0
t7 > 1s

Dip conditions for supply voltage

9.1V ≦ Vcc < 10.8V
td < 10ms

This case is based on the sequences of [Note 1].

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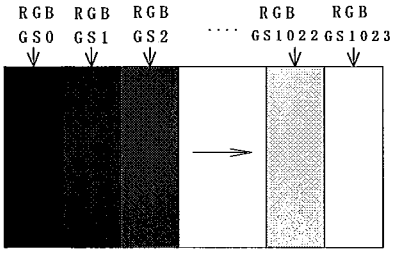
※ Data1: ACK±, AIN0±, AIN1±, AIN2±, AIN3±, AIN4±,BCK±, BIN0±, BIN1±, BIN2±, BIN3±, BIN4±
CCK±, CIN0±, CIN1±, CIN2±, CIN3±, CIN4±, DCK±, DIN0±, DIN1±, DIN2±, DIN3±, DIN4±
*$V_{CM}$ voltage pursues the sequence mentioned above

※ Data2: SELLVDS,FRAME

[Note]About the relation between data input and back light lighting, please base on the above-mentioned input sequence. When back light is switched on before panel operation or after a panel operation stop, it may not display normally. But this phenomenon is not based on change of an incoming signal, and does not give damage to a liquid crystal display.

[Note 2] Typical current situation: 1024 gray-bar patterns. (Vcc = +12.0V)
The explanation of RGB gray scale is seen in section 8.

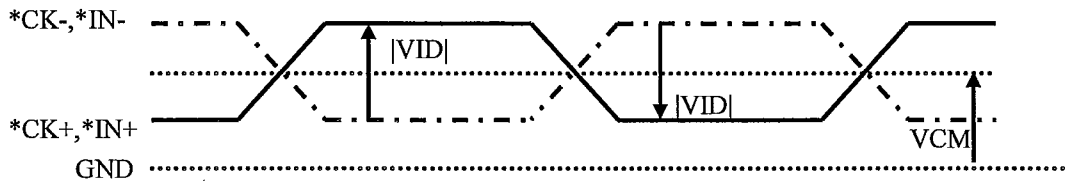



Vcc=+12.0V
CK=74.25MHz
Th=7.4μs
TV=120Hz

[Note 3] SELLVDS,FRAME

[Note 4] SELLVDS,FRAME

[Note 5] ACK±, AIN0±, AIN1±, AIN2±, AIN3±, AIN4±,BCK±, BIN0±, BIN1±, BIN2±, BIN3±, BIN4±
CCK±, CIN0±, CIN1±, CIN2±, CIN3±, CIN4±,DCK±, DIN0±, DIN1±, DIN2±, DIN3±, DIN4±




[Note 6] Vcc12V inrush current waveform

T.B.D.

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6.2. LED driving for back light

The back light system is edge light type with LEDs .

| Parameter | Symbol | Min. | Typ. | Max. | Unit | Remark |
|---|---|---|---|---|---|---|
| Operating Voltage | $V_{OP}$ | - | (+64.25) | - | V | @960mA/module (Tentative) |
| Operating Current | $I_{OP}$ | - | (960) | - | mA | 240mAx2x2 (Tentative) |

## 7. Timing characteristics of input signals

7.1. Timing characteristics

Timing diagrams of input signal are shown in Fig.2.

| Parameter | | Symbol | Min. | Typ. | Max. | Unit | Remark |
|---|---|---|---|---|---|---|---|
| Clock | Frequency | 1/Tc | (TBD) | 74.25 | (TBD) | MHz | |
| Data enable signal | Horizontal period | TH | (TBD) | 550 | (TBD) | clock | |
| | | | (TBD) | 7.41 | (TBD) | μs | |
| | Horizontal period (High) | THd | (TBD) | 480 | (TBD) | clock | |
| | Vertical period | TV | (TBD) | 1125 | (TBD) | line | |
| | | | (TBD) | 120 | (TBD) | Hz | |
| | Vertical period (High) | TVd | (TBD) | 1080 | (TBD) | line | |

[Note]-When vertical period is very long, flicker and etc. may occur.

-Please turn off the module after it shows the black screen.

-Please make sure that length of vertical period should become of an integral multiple of horizontal length of period. Otherwise, the screen may not display properly.

-As for your final setting of driving timing, we will conduct operation check test at our side, please inform your final setting.

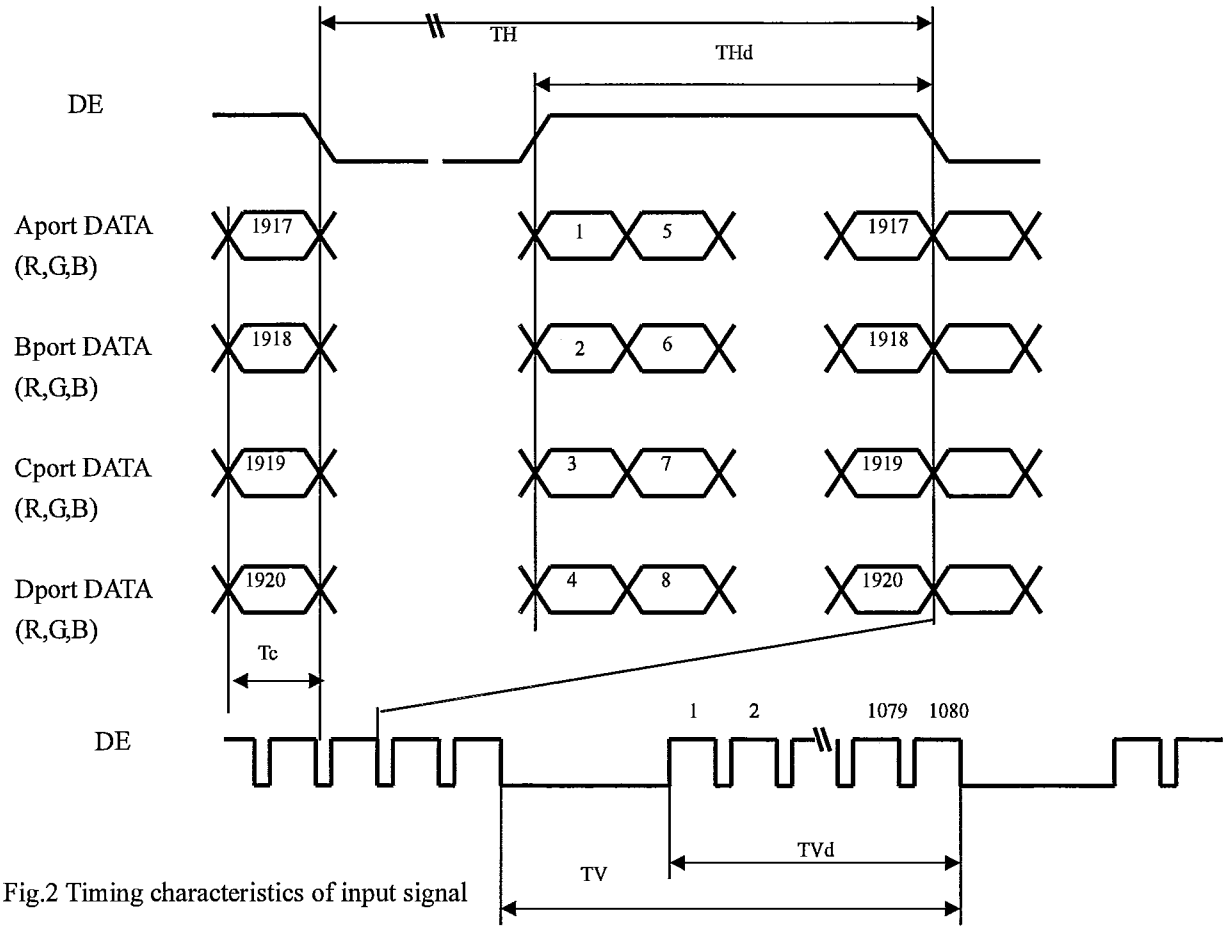


Fig.2 Timing characteristics of input signal

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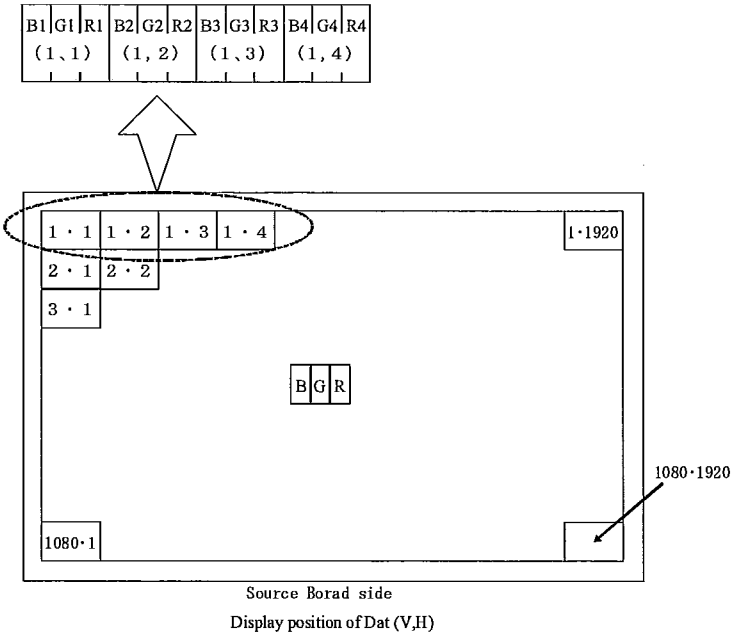
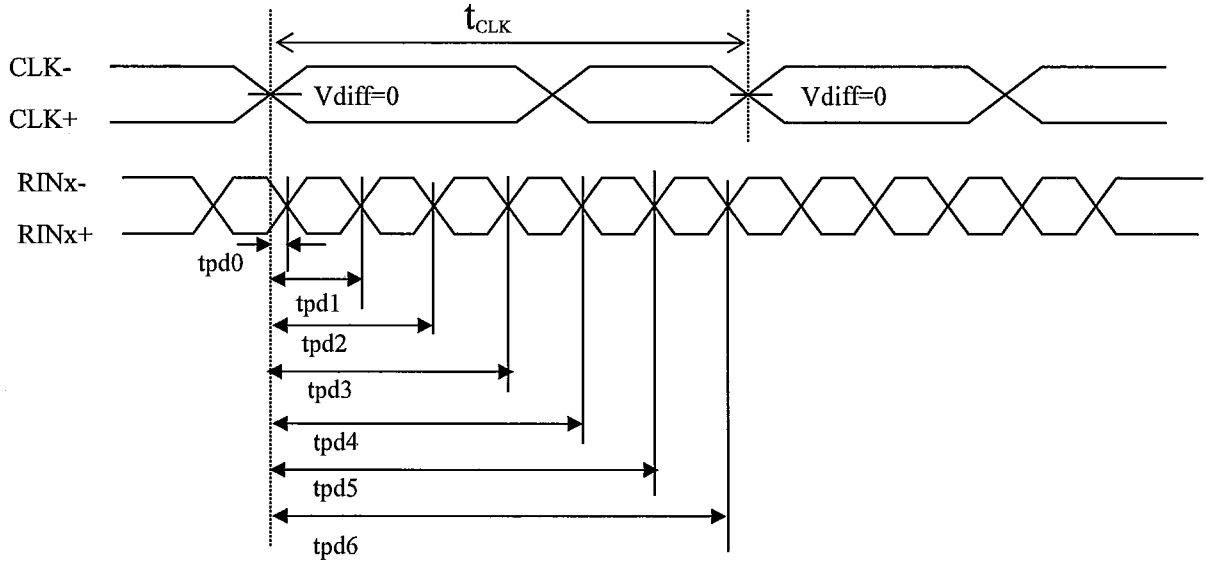
7.2 Input data signal and display position on the screen




7-3. LVDS signal characteristics




| The item | | Symbol | min. | typ. | max. | unit |
|---|---|---|---|---|---|---|
| Data position | Delay time, CLK rising edge to serial bit position 0 | tpd0 | -0.25 | 0 | 0.25 | ns |
| | Delay time, CLK rising edge to serial bit position 1 | tpd1 | 1* $t_{CLK}$ /7-0.25 | 1* $t_{CLK}$ /7 | 1* $t_{CLK}$ /7+0.25 | |
| | Delay time, CLK rising edge to serial bit position 2 | tpd2 | 2* $t_{CLK}$ /7-0.25 | 2* $t_{CLK}$ /7 | 2* $t_{CLK}$ /7+0.25 | |
| | Delay time, CLK rising edge to serial bit position 3 | tpd3 | 3* $t_{CLK}$ /7-0.25 | 3* $t_{CLK}$ /7 | 3* $t_{CLK}$ /7+0.25 | |
| | Delay time, CLK rising edge to serial bit position 4 | tpd4 | 4* $t_{CLK}$ /7-0.25 | 4* $t_{CLK}$ /7 | 4* $t_{CLK}$ /7+0.25 | |
| | Delay time, CLK rising edge to serial bit position 5 | tpd5 | 5* $t_{CLK}$ /7-0.25 | 5* $t_{CLK}$ /7 | 5* $t_{CLK}$ /7+0.25 | |
| | Delay time, CLK rising edge to serial bit position 6 | tpd6 | 6* $t_{CLK}$ /7-0.25 | 6* $t_{CLK}$ /7 | 6* $t_{CLK}$ /7+0.25 | |

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## 8. Input Signal, Basic Display Colors and Gray Scale of Each Color

| | Colors & Gray scale | Data signal | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Gray Scale | R0 | R1 | R2 | R3 | R4 | R5 | R6 | R7 | R8 | R9 | G0 | G1 | G2 | G3 | G4 | G5 | G6 | G7 | G8 | G9 | B0 | B1 | B2 | B3 | B4 | B5 | B6 | B7 | B8 | B9 |
| Basic Color | Black | – | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Blue | – | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Green | – | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Cyan | – | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Red | – | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Magenta | – | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Yellow | – | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | White | – | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Gray Scale of Red | Black | GS0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | ⇧ | GS1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Darker | GS2 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | ⇧ | ↓ | | | | | | ↓ | | | | | | | | | | ↓ | | | | | | | | | | ↓ | | | | |
| | ⇩ | ↓ | | | | | | ↓ | | | | | | | | | | ↓ | | | | | | | | | | ↓ | | | | |
| | Brighter | GS1021 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | ⇩ | GS1022 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red | GS1023 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gray Scale of Green | Black | GS0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | ⇧ | GS1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Darker | GS2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | ⇧ | ↓ | | | | | | ↓ | | | | | | | | | | ↓ | | | | | | | | | | ↓ | | | | |
| | ⇩ | ↓ | | | | | | ↓ | | | | | | | | | | ↓ | | | | | | | | | | ↓ | | | | |
| | Brighter | GS1021 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | ⇩ | GS1022 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green | GS1023 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gray Scale of Blue | Black | GS0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | ⇧ | GS1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Darker | GS2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | ⇩ | ↓ | | | | | | ↓ | | | | | | | | | | ↓ | | | | | | | | | | ↓ | | | | |
| | ⇩ | ↓ | | | | | | ↓ | | | | | | | | | | ↓ | | | | | | | | | | ↓ | | | | |
| | Brighter | GS1021 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | ⇩ | GS1022 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Blue | GS1023 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

0: Low level voltage, 1: High level voltage.

Each basic color can be displayed in 1024 gray scales from 10 bits data signals. According to the combination of total 30 bits data signals, one billion-color display can be achieved on the screen.

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## 9. Optical characteristics

Ta=25°C, Vcc=12.0V, $V_{LED}$ = (+64.25V), LED current=(960mA) and PWM=100%, Timing:120Hz (typ. value)

| Parameter | | Symbol | Condition | Min. | Typ. | Max. | Unit | Remark |
|---|---|---|---|---|---|---|---|---|
| Viewing angle range | Horizontal | $\theta$21<br>$\theta$22 | CR≧10 | 70 | 88 | - | Deg. | [Note1,4] |
| | Vertical | $\theta$11<br>$\theta$12 | | 70 | 88 | - | Deg. | |
| Contrast ratio | | CRn | $\theta$=0 deg. | (TBD) | 5000 | - | - | [Note2,4] |
| Response time | | $\tau_{DRV}$ | | | (4) | | ms | [Note3,4,5] |
| Chromaticity | White | x | | Typ.-0.03 | (TBD) | Typ.+0.03 | - | [Note4] |
| | | y | | Typ.-0.03 | (TBD) | Typ.+0.03 | - | |
| | Red | x | | Typ.-0.03 | (TBD) | Typ.+0.03 | - | |
| | | y | | Typ.-0.03 | (TBD) | Typ.+0.03 | - | |
| | Green | x | | Typ.-0.03 | (TBD) | Typ.+0.03 | - | |
| | | y | | Typ.-0.03 | (TBD) | Typ.+0.03 | - | |
| | Blue | x | | Typ.-0.03 | (TBD) | Typ.+0.03 | - | |
| | | y | | Typ.-0.03 | (TBD) | Typ.+0.03 | - | |
| Luminance | White | $Y_L$ | | (TBD) | 450 | - | cd/m$^2$ | |
| Luminance uniformity | White | δw | | - | - | (TBD) | | [Note 6] |

Measurement condition: Set the value of LED current= (960mA) and PWM=100% luminance of white.

*The measurement shall be executed 60 minutes after lighting at rating.

[Note]The optical characteristics are measured using the following equipment.

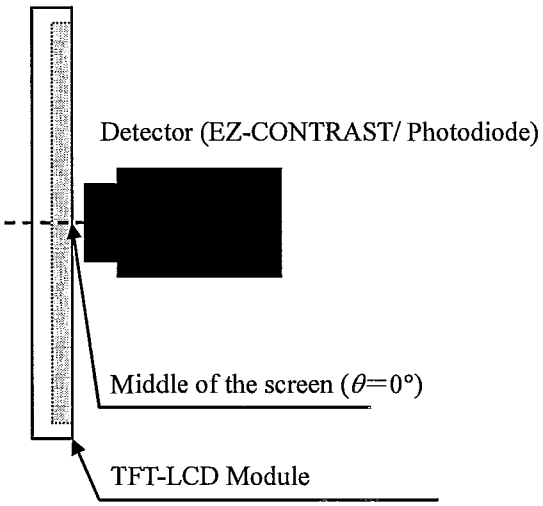


Fig.4-1 Measurement of viewing angle range and Response time.
Viewing angle range: EZ-CONTRAST
Response time: Photodiode

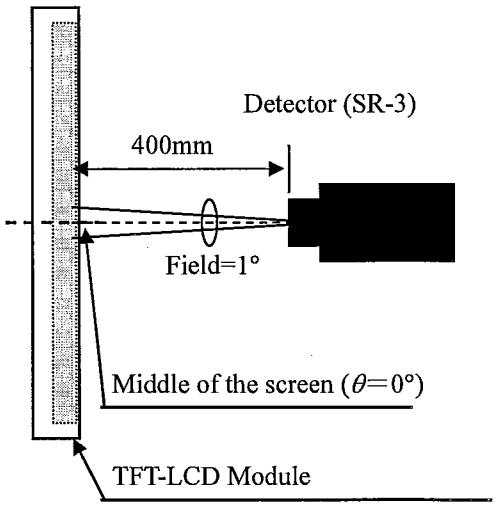


Fig.4-2 Measurement of Contrast, Luminance, Chromaticity.

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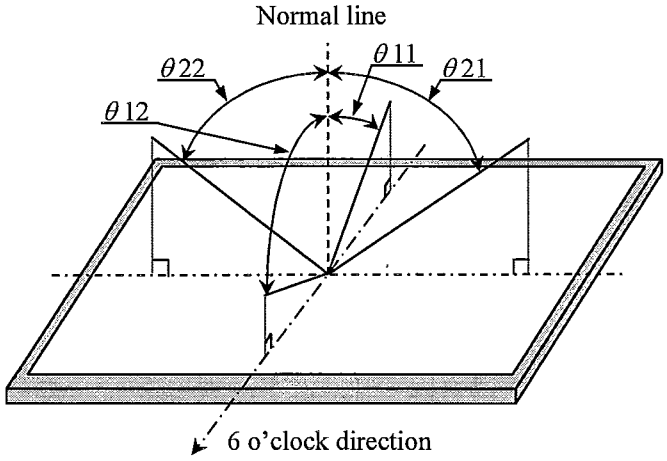
[Note 1] Definitions of viewing angle range :




[Note 2] Definition of contrast ratio :

The contrast ratio is defined as the following.

$$\text{Contrast Ratio} = \frac{\text{Luminance (brightness) with all pixels white}}{\text{Luminance (brightness) with all pixels black}}$$

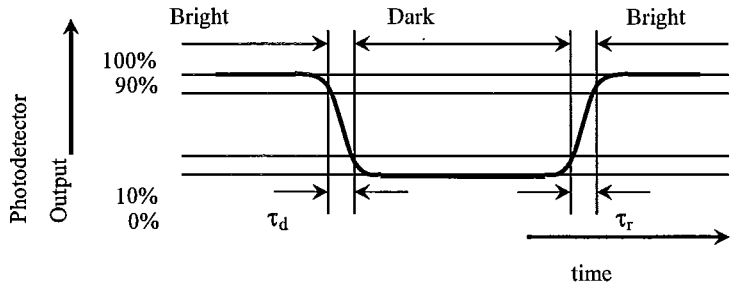
[Note 3] Definition of response time

The response time (τ) is defined as the following figure and shall be measured by switching the input signal for "any level of gray (0%, 25%, 50%, 75% and 100%)" and "any level of gray (0%, 25%, 50%, 75% and 100%)".

| | 0% | 25% | 50% | 75% | 100% |
|---|---|---|---|---|---|
| 0% | | tr:0%-25% | tr:0%-50% | tr:0%-75% | tr:0%-100% |
| 25% | td: 25%-0% | | tr: 25%-50% | tr25%-75% | tr: 25%-100% |
| 50% | td: 50%-0% | td: 50%-25% | | tr: 50%-75% | tr: 50%-100% |
| 75% | td: 75%-0% | td: 75%-25% | td: 75%-50% | | tr: 75%-100% |
| 100% | td: 100%-0% | td: 100%-25% | td:100%-50% | td:100%-75% | |

t*:x-y...response time from level of gray(x) to level of gray(y)

$\tau = \Sigma(t^*:x\text{-}y)/20$




[Note 4] This shall be measured at center of the screen.

[Note 5] This value is valid when O/S driving is used at typical input time value.

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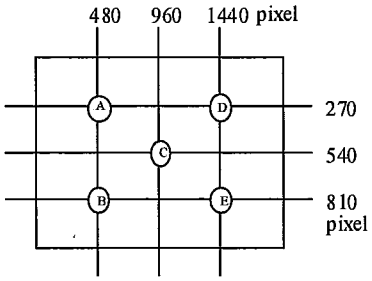
[Note 6] Definition of white uniformity ;

White uniformity is defined as the following with five measurements. (A~E)

$$\delta w = \frac{\text{Maximum luminance of five points (brightness)}}{\text{Minimum luminance of five points (brightness)}}$$




## 10. Handling Precautions of the module

a) Be sure to turn off the power supply when inserting or disconnecting the cable.

b) Voltage difference generated by this switching, $\Delta V_{LED}$, may affect a sound output, etc. when the power supply is shared between the LED driver and its surrounding circuit. So, separate the power supply of the LED driver circuit with the one of its surrounding circuit.
*Since LED driver board's GND is not connected to the frame of the LCD module, please connect it with the Customer's GND of LED driver power supply.

c) Be sure to design the cabinet so that the module can be installed without any extra stress such as warp or twist.

d) Since the front polarizer is easily damaged, pay attention not to scratch it.

e) Since long contact with water may cause discoloration or spots, wipe off water drop immediately.

f) When the panel surface is soiled, wipe it with absorbent cotton or other soft cloth.

g) Since the panel is made of glass, it may break or crack if dropped or bumped on hard surface. Handle with care.

h) Since CMOS LSI is used in this module, take care of static electricity and take the human earth into consideration when handling.

i) The module has some printed circuit boards (PCBs) on the back side, take care to keep them form any stress or pressure when handling or installing the module; otherwise some of electronic parts on the PCBs may be damaged.

j) Observe all other precautionary requirements in handling components.

k) When some pressure is added onto the module from rear side constantly, it causes display non-uniformity issue, functional defect, etc. So, please avoid such design.

l) When giving a touch to the panel at power on supply, it may cause some kinds of degradation. In that case, once turn off the power supply, and turn on after several seconds again, and that is disappear.

m) When handling LCD modules and assembling them into cabinets, please be noted that long-term storage in the environment of oxidization or deoxidization gas and the use of such materials as reagent, solvent, adhesive, resin, etc. which generate these gasses, may cause corrosion and discoloration of the LCD modules.

n) This LCD module is designed to prevent dust from entering into it. However, there would be a possibility to have a bad effect on display performance in case of having dust inside of LCD module. Therefore, please ensure to design your TV set to keep dust away around LCD module.

o) This LCD module passes over the rust.

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## 11. Packing form

a) Piling number of cartons : (T.B.D)
b) Packing quantity in one carton : (T.B.D)
c) Carton size : (T.B.D)
d) Total mass of one carton filled with full modules : (T.B.D)

## 12. Reliability test item

| No. | Test item | Condition |
|---|---|---|
| 1 | High temperature storage test | Ta=60°C 240h |
| 2 | Low temperature storage test | Ta=-10°C 240h |
| 3 | High temperature and high humidity operation test | Ta=40°C ; 95%RH 240h<br>(No condensation) |
| 4 | High temperature operation test | Ta=50°C 240h |
| 5 | Low temperature operation test | Ta=0°C 240h |
| 6 | Vibration test<br>(non-operation) | Frequency: 10~57Hz/Vibration width (one side): 0.075mm<br>: 58~500Hz/Acceleration: 9.8 m/s²<br>Sweep time: 11 minutes<br>Test period: 3 hours (1h for each direction of X, Y, Z) |
| 7 | Shock test<br>(non-operation) | Maximum acceleration: 294m/s$^2$<br>Pulse width: 11ms, sinusoidal half wave<br>Direction: +/-X, +/-Y, +/-Z, once for each direction. |
| 8 | ESD | * At the following conditions, it is a thing without incorrect operation and destruction.<br>(1)Non-operation: Contact electric discharge ±10kV<br>Non-contact electric discharge ±20kV<br>(2)Operation Contact electric discharge ±8kV<br>Non-contact electric discharge ±15kV<br>Conditions: 150pF, 330ohm |

[Result evaluation criteria]

Under the display quality test condition with normal operation state, there shall be no change, which may affect practical display function.

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## 13. Others

1) Lot No. Label ;

T.B.D

2) Packing Label

T.B.D

3) Adjusting volume has been set optimally before shipment, so do not change any adjusted value. If adjusted value is changed, the specification may not be satisfied.
4) Disassembling the module can cause permanent damage and should be strictly avoided.
5) Please be careful since image retention may occur when a fixed pattern is displayed for a long time.
6) The chemical compound, which causes the destruction of ozone layer, is not being used.
7) When any question or issue occurs, it shall be solved by mutual discussion.
8) This module is corresponded to RoHS.

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## 14. Carton storage condition

| | |
|---|---|
| Temperature | 0°C to 40°C |
| Humidity | 95%RH or less |
| Reference condition | : 20°C to 35°C, 85%RH or less (summer) |
| | : 5°C to 15°C, 85%RH or less (winter) |
| | the total storage time (40°C,95%RH) : 240H or less |
| Sunlight | Be sure to shelter a product from the direct sunlight. |
| Atmosphere | Harmful gas, such as acid and alkali which bites electronic components and/or wires must not be detected. |
| Notes | Be sure to put cartons on palette or base, don't put it on floor, and store them with removing from wall<br>Please take care of ventilation in storehouse and around cartons, and control changing temperature is within limits of natural environment |
| Storage life | 1 year |

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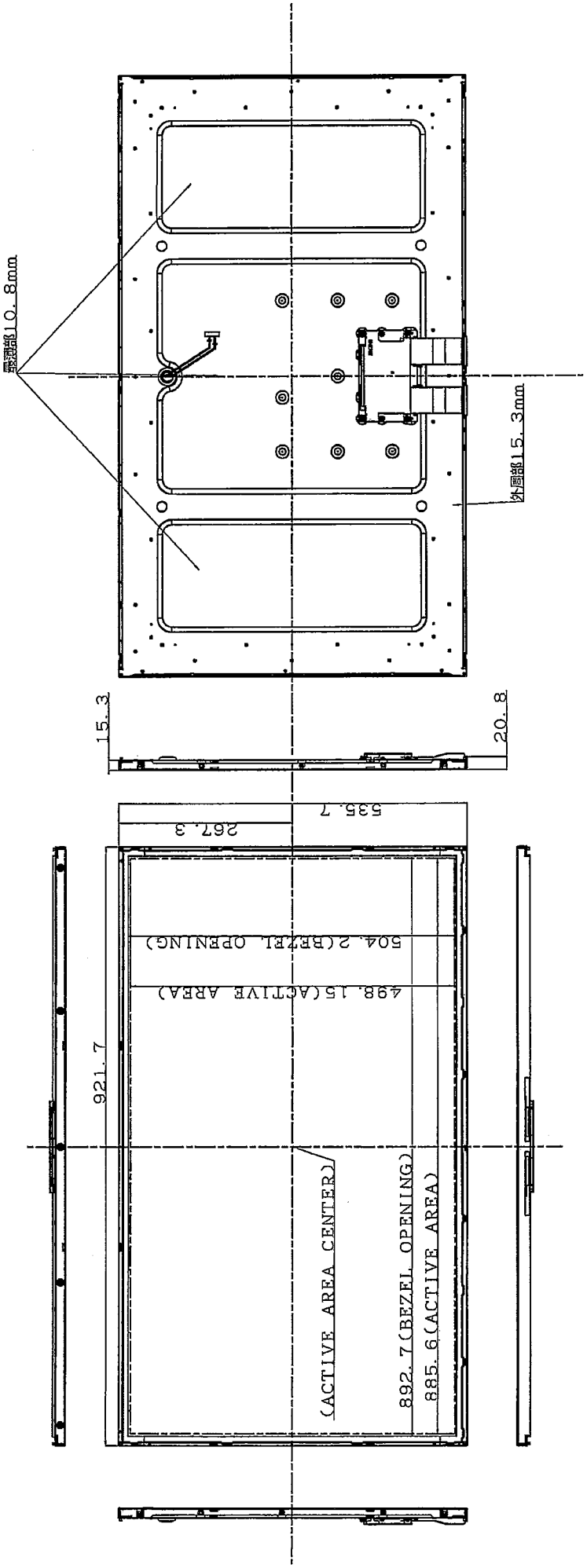
LD-k22569-20

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